UNIVERSITY OF LEIPZIG
INSTITUTE FOR THEORETICAL PHYSICS
Department: Theory of Elementary Particles

TP2 2015

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List of problems 3

7. Each of two charged spheres of radius a, one conducting and one having a spherically symmetric charge density that varies radially as r^n $(n > -3)$, has a total charge Q. Use Gauss's theorem to obtain the vector of the electric fields both inside and outside each sphere.
   Sketch the behavior of the fields as a function of the radius for the first sphere, and for the second with $n = -2, +2$.
   Hint: Inside a conductor the electric field is zero.

8. A sphere of radius R_1 has charge density ρ uniform within its volume, except for a small spherical hollow region of radius R_2 located at a distance a from the center $(R_2 + a < R_1)$.
   (a) Find the electric field E inside the hollow sphere.
   (b) Find the potential Φ at the center of the hollow sphere.
   Hint: Use the superposition of two uniformly and oppositely charged spheres.

9. An amount of charge q is uniformly spread out in a layer on the surface of a disc of radius a.
   Find the electrostatic potential $\Phi(z)$ at any point on the axis of symmetry $(z > 0$ and $z < 0)$. Calculate the vector of the electric field $\mathbf{E}(z)$ on that axis.